Docket No.: APPM/002592.C7/DSM/LOW K/JW
1016.013386
(PATENT)

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

In re Application of: Wai-Fan Yau, et al.	§	
	§	Group Art Unit: 2823
Serial No.: 10/756,122	§	
Confirmation No.: 4554	§	
	§	Examiner: Julio J. Maldonado
Filed: January 13, 2004	§	
For: A Low Dielectric Constant Film Produced from Silicon Compounds Comprising Silicon-Carbon Bond	§	

APPEAL BRIEF

MS APPEAL BRIEF - PATENTS
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

I hereby certify that this paper (along with any paper referred to as being attached or enclosed) is being transmitted via the Office electronic filing system in accordance with § 1.6(a)(4).
Dated: 10/9/08 Signature: _____
(Keith M. Tackett)

Dear Sir:

Applicants submit this Appeal Brief to the Board of Patent Appeals and Interferences on appeal from the decision of the Examiner of Group Art Unit 2823 dated July 22, 2008, finally rejecting claims 15-18, 21-25, 27, and 28. The final rejection of claims 15-18, 21-25, 27, and 28 is appealed. This Appeal Brief is believed to be timely since electronically transmitted by the due date of October 29, 2008, as set by electronically transmitting a Notice of Appeal on August 29, 2008. Authorization to charge the fee of $540.00 for filing this Appeal Brief, and any additional fees that may be required to make this Appeal Brief timely and acceptable to the Office, is provided on a separate fee transmittal.

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Real Party in Interest

The present application has been assigned to Applied Materials, Inc., 3050 Bowers Avenue, Santa Clara, California 95054.

Related Appeals and Interferences

Applicant asserts that no other appeals or interferences are known to the Applicant, the Applicant's legal representative, or assignee which will directly affect or be directly affected by or have a bearing on the Board's decision in the pending appeal.

Status of Claims

Claims 15-18, 21-25, 27, and 28 are pending in the application. Claims 1-20 were originally presented in the application. A Non-Final Office Action was mailed February 23, 2005, wherein the Examiner rejected claims 1-20. Applicants filed a Response on March 23, 2005, amending claims 1, 2, 5, 7, 10-13, 15, and 17, cancelling claims 4, 14, 19, and 20 without prejudice, and adding claim 21. A Final Office Action was mailed June 17, 2005, wherein the Examiner rejected claims 1-3, 5-13, 15-18, and 21. Applicants filed a Response on July 19, 2005, cancelling claims 1-3, 5-7, 9, and 10 without prejudice, and rewriting claim 8 in independent form. A Non-Final Office Action was mailed July 29, 2005, wherein the Examiner rejected claims 8, 11-13, 15-18, and 21. Applicants filed a Response on October 3, 2005, cancelling claim 8 without prejudice and added new claims 22-28. A Non-Final Office Action was mailed December 22, 2005, wherein the Examiner rejected claims 11-13, 15-18, 21, and 23-28, and objected to claim 22 as being dependent upon a rejected base claim. Applicants filed a Response on March 21, 2006, amending claims 17 and 25. A Non-Final Office Action was mailed May 12, 2006, wherein the Examiner rejected claims 11-13, 15-18, 21, and 23-28 and objected to claim 22. Applicants filed a Response on June 20, 2006, amending no claims. A Non-Final Office Action was mailed on October 27, 2006, wherein the Examiner rejected claims 11-13, 15-18, and 21-28. Applicants filed a Response on December 18, 2006, amending no claims. A Non-Final Office Action was mailed on April 24, 2007, wherein the Examiner rejected claims 11-13, 15-18, and 21-28. Applicants filed a Response on June 29, 2007, amending no claims. A Final Office Action was mailed on September 25, 2007, where the Examiner finally rejected claims 11-13, 15-18, and 21-28. Applicants filed a Response on October 23, 2007, cancelling claims 11-13 without prejudice. A Final Office Action was mailed on November 7, 2007, wherein the Examiner rejected claims 15-18 and 21-28. Applicants filed a Response on November 29, 2007, cancelling claim 26 without prejudice. A Non-Final Office Action was mailed March 5, 2008, wherein the Examiner rejected claims 15-18, 21-25, 27, and 28. Applicants filed a Response on March 5, 2008, amending no claims. Claims 15-18, 21-25, 27, and 28 stand finally rejected. The final rejections of

claims 15-18, 21-25, 27, and 28 are appealed. The pending claims are shown in the attached Claims Appendix.

Status of Amendments

All claim amendments have been entered by the Examiner and are reflected in the listing of claims included in the Claims Appendix.

Summary of Claimed Subject Matter

Embodiments of the invention provide a method comprising depositing on a substrate (Fig. 10E, item 712; paragraph [0069], line 2) a plurality of layers (Fig. 10E, items 710, 714, 718, 722, and 726; paragraph [0069], lines 1-20), wherein one or more of the layers is a low dielectric constant oxidized organosilane layer (Figure 10E, item 714; paragraph [0069], lines 4-5) comprising carbon (paragraph [0028], lines 8-9), wherein the low dielectric constant oxidized organosilane layer is deposited in a plasma enhanced process (paragraph [0055], lines 3-5) from a mixture comprising a methylsilane compound and an oxidizing gas (paragraph [0029], lines 9-14), the carbon content of the low dielectric constant oxidized organosilane layer is from 1% to 50% by atomic weight (paragraph [0029], lines 14-15), and a top layer of the plurality of layers is a photoresist (Fig. 10E, item 726; paragraph [0069], line 20).

Grounds of Rejection to be Reviewed on Appeal

1. Claims 15-18, 21, 23-25, 27, and 28 are rejected under 35 U.S.C. § 103(a) as being unpatentable over *Chiang, et al.* (U.S. Pat. No. 5,817,572, hereinafter "Chiang") in view of *Matsuura* (U.S. Pat. No. 6,124,641, hereinafter "Matsuura") and *Hu, et al.* (U.S. Pat. No. 5,718,967, hereinafter "Hu")

2. Claim 22 is rejected under 35 U.S.C. § 103(a) as being unpatentable over Chiang in view of Matsuura and Hu as applied to claims 15-18, 21, 23-25, 27, and 28 and further in view of *Chen* (U.S. Pat. No. 5,970,376, hereinafter "Chen").

ARGUMENTS

A. Claims 15-18, 21, 23-25, 27, and 28 are not obvious over Chiang in view of Matsuura and Hu because the references do not teach, show, or suggest the elements of the claimed invention, and one of ordinary skill in the art would not find the claimed invention obvious from the cited references.

Claims 15-18, 21 and 23-25, 27 and 28 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Chiang in view of Matsuura and Hu on the grounds that one of ordinary skill in the art at the time of the invention would have found it obvious to make the claimed invention from studying the references.

A rejection based on obviousness must be grounded in the analysis of *Graham v. John Deere Co*, 383 U.S. 1 (1966). *KSR Int'l Co. v. Teleflex, Inc.*, 127 S. Ct. 1727, 1734 (2007). In resolving the *Graham* analysis, an Examiner must determine the scope and content of the prior art, the differences between the prior art and the claimed invention, and the level of skill of the ordinary practitioner at the time of the invention. *Graham*, at 17-18. Although the Examiner need not cite precise teachings directed to the specific subject matter of the challenged claim, *KSR*, at 1740-41, a rejection on obviousness grounds cannot be sustained by mere conclusory statements; instead, there must be some articulated reasoning with some rational underpinning to support the legal conclusion of obviousness, *In re Kahn*, 441 F.3d 977, 978 (Fed. Cir. 2006). The prior art must provide some support for the legal conclusion of obviousness. *See, e.g., Takeda Chem. Indus. v. Alphapharm*, 492 F.3d 1350, 1356 (Fed. Cir. 2007). Where such underpinning is absent, a rejection for obviousness cannot stand. *See Whalen II*[1], at *13-*16 (BPAI July 23, 2008). Moreover, if the result of combining prior art elements would not have been predictable to one of ordinary skill in the art, combining those elements is not obvious. *Cf., KSR*, at 1739-40.

[1] http://www.uspto.gov/web/offices/dcom/bpai/prec/fd074423.pdf

The Examiner asserts that Chiang teaches a method of forming interconnect structure including depositing a series of layers culminating in a photoresist layer, the layers including dielectric layers which may be silicon dioxide, silicon nitride, silicon oxynitride, phosphosilicate glass, borophosphosilicate glass, fluoropolymer, parylene, polyimide, spin-on glass, or a spin-on polymer, using the photoresist layer to form a contact hole, and then forming a third dielectric layer. The Examiner acknowledges that Chiang fails to disclose use of the claimed low dielectric constant materials or forming a low dielectric constant organosilane layer in a plasma-enhanced CVD process from a mixture comprising a methylsilane compound and an oxidizing gas, the carbon content of the low dielectric constant oxidized organosilane layer being from 1% to 50% by atomic weight. The Examiner asserts, however, that Matsuura teaches the low dielectric constant oxidized organosilane layer deposited by PECVD from methylsilane and hydrogen peroxide missing from Chiang, and that it would be obvious to combine the teachings of Matsuura with Chiang to yield the claimed invention. Applicants respectfully traverse the rejection on the grounds that one of ordinary skill in the art would not have found it obvious to combine relevant elements of these three references to yield the claimed invention.

Chiang teaches formation of a plurality of layers on a substrate, but none is disclosed to be a low dielectric constant oxidized organosilane layer. The layers taught by Chiang are silicon nitride, silicon dioxide (doped or undoped), silicon oxynitride, fluoropolymer, parylene, or polyimide (Chiang, col. 6, lines 49-52), but Chiang does not disclose forming the layers as oxidized organosilane layers in a plasma enhanced process using a mixture comprising a methylsilane compound and an oxidizing gas. Nor does Chiang teach the carbon content of the layer.

Matsuura teaches formation of an insulating layer using methylsilane and hydrogen peroxide in a chemical vapor deposition process without using plasma (Matsuura col. 4, lines 30-59). Matsuura teaches forming other films in the same structure using plasma (Matsuura col. 4, lines 17-29). Matsuura teaches that the film formed from methylsilane and hydrogen peroxide is formed at temperatures below room temperature and at pressures from 500 to 2,000 mTorr (Matsuura col. 4, lines 47-59). Matsuura also teaches

that dimethylsilane and ethylsilane may be blended with, or substituted for, methylsilane (Matsuura col. 6, lines 5-60). Matsuura also discloses that the insulating layer contains carbon (Matsuura col. 5, lines 16-26), that the dielectric constant can be reduced (Id. col. 5, line 33), and that the dielectric constant of the subject insulating layer is lower than that of spin-on glass (Id. col. 5, lines 62-65). Matsuura does not disclose, however, formation of a low dielectric constant layer using a plasma process.

Hu teaches formation of an SiO_x layer which is a plasma polymerized organosilicon compound (Hu col. 3, lines 18-19). Hu teaches that numerous precursors may be used to form the layer, including silanes, siloxanes, and silazanes. The silanes disclosed by Hu all carry alkoxy groups in addition to other alkyl groups, such as methyl, vinyl, and phenyl groups. Hu does not teach that the layer deposited by the plasma process retains silicon-carbon bonds, or that the deposited layer is a low dielectric constant layer.

Applicants have argued that one of ordinary skill in the art would not find it obvious to apply the plasma process of Hu and the precursors of Matsuura to the process of Chiang to make the claimed invention. The Examiner states that one of ordinary skill in the art would have been motivated to look to analogous art teaching alternative suitable or useful methods of performing the steps of Chiang and Matsuura (Final Office Action, p. 5, lines 2-4), implying that Hu teaches an alternative suitable or useful method. As discussed above, however, Hu does not teach that a low dielectric constant layer can be deposited using a plasma process. Chiang also does not teach use of a plasma process, and Matsuura uses plasma to deposit layers of various composition, except for the layer deposited using a methylsilane compound and an oxidizing gas as precursors. The Examiner asserts that because Matsuura is open to different CVD processes, such as plasma CVD, and Hu teaches use of plasma for forming a dielectric layer, formation of a low dielectric constant layer from a methylsilane compound and an oxidizing gas using a plasma process would have been a predictable result of the combined elements.

Although Matsuura discloses formation of an insulating layer from methyl silane and hydrogen peroxide, and that the insulating layer contains carbon, this is not sufficient to

disclose that the Matsuura film is a low dielectric constant film. Moreover, it would not have been obvious to one of ordinary skill in the art that applying plasma to the Matsuura process would preserve any carbon in the deposited film. To deposit a film containing carbon from the Matsuura precursors, it is necessary to leave some silicon-carbon bonds undisturbed. The combined references provide no indication that suitable conditions could be found using the plasma process of Hu that would deposit a film having silicon-carbon bonds from the Matsuura precursors. One of ordinary skill in the art would understand that the silicon-carbon bond in methylsilane is relatively reactive, especially judging from the reaction conditions of the Matsuura process. One of ordinary skill in the art would recognize that the most likely result of adding the Hu plasma process to the Matsuura process would be to deposit a silicon oxide layer devoid of carbon. This would be further reinforced by the fact that none of the cited references discloses depositing a carbon-containing film using methylsilane, or a methylsilane compound, with plasma, and none of the cited references discloses depositing a low dielectric constant layer using plasma.

Applicants therefore submit that Chiang, Matsuura, and Hu, alone or in combination, do not teach, show, suggest, or make obvious a method comprising depositing on a substrate a plurality of layers, wherein one or more of the layers is a low dielectric constant oxidized organosilane layer comprising carbon, wherein the low dielectric constant oxidized organosilane layer is deposited in a plasma enhanced process from a mixture comprising a methylsilane compound and an oxidizing gas, the carbon content of the low dielectric constant oxidized organosilane layer is from 1% to 50% by atomic weight, and a top layer of the plurality of layers is a photoresist, as recited by claim 15 and claims dependent thereon. Applicants respectfully request the rejection be withdrawn.

B. Claim 22 is not obvious over Chiang in view of Matsuura and Hu as applied to claims 15-18, 21 and 23-25, 27, and 28 and further in view of Chen, because the references do not teach, show, or suggest the elements of the claimed invention.

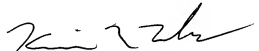
Claim 22 stands rejected under 35 U.S.C. § 103(a) as being unpatentable over Chiang in view of Matsuura and Hu as applied to claims 15-18, 21 and 23-25, 27, and 28 and further in view of Chen. Applicants respectfully traverses the rejection.

Chiang, Matsuura, and Hu are discussed above. Chen does not remedy the deficiency of Chiang, Matsuura, and Hu. Applicants therefore respectfully request the rejection be withdrawn.

CONCLUSION

For the reasons stated above, Applicants respectfully submit that the rejection of claims 15-18, 21-25, 27, and 28 is improper. Reversal of the rejections is respectfully requested.

Respectfully submitted,



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CLAIMS APPENDIX

1-14. (Cancelled)

15. (Previously Presented) A method comprising depositing on a substrate a plurality of layers, wherein one or more of the layers is a low dielectric constant oxidized organosilane layer comprising carbon, wherein the low dielectric constant oxidized organosilane layer is deposited in a plasma enhanced process from a mixture comprising a methylsilane compound and an oxidizing gas, the carbon content of the low dielectric constant oxidized organosilane layer is from 1% to 50% by atomic weight, and a top layer of the plurality of layers is a photoresist.

16. (Original) The method of claim 15, wherein the plurality of layers further comprises a layer selected from the group consisting of parylene, FSG, silicon oxide, and silicon nitride layers.

17. (Previously Presented) The method of claim 15, wherein the plurality of layers comprises two low dielectric constant oxidized organosilane layers and an etch stop layer adjacent to both of the two low dielectric constant oxidized organosilane layers.

18. (Original) The method of claim 17, wherein the etch stop layer is a silicon oxide or silicon nitride layer.

19-20. (Cancelled)

21. (Previously Presented) The method of claim 15, wherein the methylsilane compound has the formula $SiH_n(CH_3)_{4-n}$, where n=1 to 3 or $Si_2H_m(CH_3)_{6-m}$, where m=1 to 5.

22. (Previously Presented) The method of claim 15, further comprising etching the low dielectric constant oxidized organosilane layer using fluorine, carbon, and oxygen ions.

23. (Previously Presented) The method of claim 15, wherein the plurality of layers comprises one low dielectric constant oxidized organosilane layer comprising carbon.

24. (Previously Presented) The method of claim 23, wherein the low dielectric constant oxidized organosilane layer comprising carbon is between two dielectric layers in the plurality of layers.

25. (Previously Presented) The method of claim 15, wherein the methylsilane compound is methyl silane (CH_3SiH_3).

26. (Canceled)

27. (Previously Presented) The method of claim 15, wherein the low dielectric constant oxidized organosilane layer is deposited in the presence of RF power.

28. (Previously Presented) The method of claim 15, further comprising etching a pattern in the plurality of layers.

EVIDENCE APPENDIX

No evidence pursuant to §§ 1.130, 1.131, or 1.132 or entered by or relied upon by the Examiner is being submitted.

RELATED PROCEEDINGS APPENDIX

No related proceedings are referenced above, hence copies of decisions in related proceedings are not provided.